oxide and/or silicon oxynitride) 105 and 106 are formed on the substrate over the first film 104 (see Figs. 1(c)-1(d)). A resist or mask 107 is then formed on the substrate and used for etching an aperture in layers 105 and 106 (see Fig. 1(d)). The etching of layers 105-106 causes a reaction product 108 to form on an exposed portion of underlying layer 104. This byproduct 108 is then removed in a second etching step using *oxygen (O) inclusive gas that is free of fluorine (F)* (see Fig. 2(e)). Thereafter, in a third etching step, another gas is used to etch an aperture in silicon nitride layer 104, which again causes another reaction product 109 to form on an exposed portion of underlying semiconductor substrate 101 (see Fig. 2(f)). A fourth etching step using an *oxygen (O) inclusive gas free of fluorine (F)* is then used to remove reaction product 109 to expose the semiconductor substrate 101 in the contact hole or via, and thereafter the resist 107 is removed (see Fig. 2(g)). The undesirable reaction products 108, 109 are formed as a result of *fluoro*carbon reactions during the etching. To remove these undesirable *fluoro*carbon reaction products 108, 109, oxygen inclusive gas is used which is free of F (e.g., pg. 14, line 25 to pg. 15, line 8).

Claim 1 stands rejected under 35 U.S.C. Section 102(e) as being allegedly anticipated by Ou-Yang (US 6,379,574). This Section 102(e) rejection is respectfully traversed for at least the following reasons.

Claim 1 requires "a second step of <u>removing a reaction product deposited on the first film through the first step with a second *etching gas comprising O and free of F* to expose the first film</u>; a third step of etching the first film exposed through the second step with a third etching gas until the conductive layer is exposed; and a fourth step of

removing a reaction product deposited on the conductive layer through the third step with a fourth *etching gas comprising O and being free of F*, thereby forming a concave portion penetrating the first and second films to reach the conductive layer surface, so that *no F gas is used during removal of the reaction products*." The cited art fails to disclose or suggest these aspects of claim 1.

Ou-Yang discloses a method of making a circuit device wherein metallic Al (aluminum) layer 52, TiN or SiON (silicon oxynitride) layer 54, and dielectric (e.g., SiO_2) layer 56 are formed on semiconductor substrate 50 (e.g., col. 6, lines 5-11 and 26-31). Resist 58 is used to etch a hole in dielectric layer 56 thereby forming byproduct 62 in the etched hole as best shown in Fig. 7. Thereafter, a flushing step using oxygen-based plasma is performed to flush out fluorine species remaining in the chamber (e.g., col. 6, line 62 to col. 7, line 8). Then, Ou-Yang uses a treatment is performed using *fluorocarbon* gas to remove byproduct 62 (e.g., col. 7, lines 32-60). Thus, it can be seen that Ou-Yang significantly differs from the invention of claim 1 since Ou-Yang uses a fluorocarbon gas such as CHF_3 in order to remove the undesirable byproduct 62 (e.g., col. 3, lines 41-48; and col. 7, lines 47-50). In contrast, certain embodiments of the instant invention teach the use of O (oxygen) gas free of F (fluorine) for removing the undesirable byproducts.

Claim 1 clearly requires that the second and fourth gases comprises O but are free of F, and that no F gas is used during removal of the reaction products. Oh-Yang's use of F inclusive gas thereby teaches directly away from the invention of claim 1, and is highly undesirable since it may cause additional undesirable fluorocarbon byproducts to form

which the invention of claim 1 seeks to avoid. Claim 1 cannot be anticipated, or otherwise rendered unpatentable, in view of Oh-Yang due to Oh-Yang's use of F inclusive gas to remove byproducts.

Claim 9 requires that "at least one of the second and fourth gases comprises oxygen and is free of F, so that no F gas is used during removal of at least one of the reaction products." Again, the cited art fails to disclose or suggest this aspect of claim 9.

For at least the foregoing reasons, it is respectfully requested that all rejections be withdrawn. All claims are in condition for allowance. If any minor matter remains to be resolved, the Examiner is invited to telephone the undersigned with regard to the same.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

1. (*Amended*) A method of manufacturing a semiconductor device comprising:

a first step of depositing a first film and a second film on a conductive layer in this order and etching a desired portion of the second film with a first etching gas until the first film is exposed, the first film being made of one of a silicon nitride film and a silicon nitride oxide film, the second film being made of a silicon oxide film;

a second step of removing a reaction product deposited on the first film through the first step with a second etching gas comprising O and free of F to expose the first film;

a third step of etching the first film exposed through the second step with a third etching gas until the conductive layer is exposed; and

a fourth step of removing a reaction product deposited on the conductive layer through the third step with a fourth etching gas comprising O and being free of F, thereby forming a concave portion penetrating the first and second films to reach the conductive layer surface, so that no F gas is used during removal of the reaction products.

Please add the following new claims:

8. (*New*) The method of claim 1, wherein the conductive layer is a semiconductor substrate.

9. (*New*) A method of manufacturing a semiconductor device, the method comprising:

depositing a first film comprising silicon nitride on a conductive layer, and thereafter depositing a second film comprising silicon oxide over the first film comprising silicon nitride;

etching a desired portion of the second film comprising silicon oxide with a first etching gas to form an aperture in the second film,

using a second etching gas to remove a first reaction product deposited on the first film under said aperture defined in the second film, the first reaction product having been formed due to said etching of the second film;

after removing the first reaction product, using a third etching gas to etch the first film at an area where the first reaction product was removed until the conductive layer is exposed thereby forming an aperture in the first film over an exposed area of the conductive layer;

using a fourth gas to remove a second reaction product deposited on the conductive layer under said aperture defined in the first film, the second reaction product having been formed due to said etching of the first film, thereby forming a concave portion penetrating the first and second films to reach the conductive layer; and

wherein at least one of the second and fourth gases comprises oxygen and is free of F, so that no F gas is used during removal of at least one of the reaction products.

10. (*New*) A method according to claim 9, wherein all of the recited steps are successively carried out in a single apparatus maintaining therein a vacuum state.

11. (*New*) A method according to claim 9, wherein the first etching gas comprises at least one of CHF_3, C_4F_8 and C_5F_8.

12. (*New*) A method according to claim 9, wherein the third etching gas comprises at least one of CHF_3 and CH_2F_2.

13. (*New*) A method according to claim 9, wherein the etching using the second and fourth gas(es) is carried out under plasma conditions.

14. (*New*) A method according to claim 9, wherein the conductive layer is a semiconductor substrate, and the concave portion is a contact hole.

15. (*New*) A method according to claim 9, wherein the conductive layer is a layered substrate on which an electrode is layered and the concave portion is a via hole.